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Need for Upgradation of Technologies in Water Supply Projects in India

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Abstract: ***India, water supply services in urban and rural areas in India are provided mainly by public authorities. These authorities are mostly involved in operation and maintenance of the water supply schemes. When any additional fund becomes available, expansion of pipe network, additional house connections and repair works are taken up. But, there is an urgent need for upgradation of technologies in the water supply schemes. At present, there is not much effort for upgradation of technologies for treatment of water, measurement and control of system, increase in efficiency of pumping stations and water distribution network, etc. The author highlights some of the feasible technologies, which may be evaluated and adopted by water authorities. For technology upgradation, enormous works are needed in India, which in turn will necessitate research and generate employment and business opportunities to Industries.***
Keywords: Upgradation of Technology, Water Treatment, Water Quality Assessment, Smart Water Meters, Water Quality Sensor, Smart Water Grid.

I. INTRODUCTION AND CONTEXT

In India, most of the public water authorities are pre occupied with day to day operation and maintenance works and struggling to provide day to day water supply service. They are also involved in expansion of pipe water supply network and service coverage. Technology upgradation is considered as higher level interventions and generally no fund is allocated for the purpose. Most of the existing water supply schemes are designed and running with old technologies. Performance of the schemes in producing and supplying adequate quality of water is not satisfactory. The performance is also affected by inadequate operation and maintenance. Therefore, technological upgradation in water supply schemes is urgently needed. Some of the technology upgradation requirements are listed below:

1) *Efficient Intake Works:* There should be smooth withdrawal of water from surface water sources even in lean flow period of sources. Pumping machinery at the pumping stations needs to be versatile and fully functional at different flow conditions in surface water source.
2) *Design of water Treatment Plants with Less Land or Space Requirement:* Land availability in urban areas for construction of new water treatment plant and expansion of existing plants are limited. Hence, treatment plants need to be designed with minimum land requirement.
3) *Water Treatment with less Maintenance Requirement:* Treatment plants need to be designed to ensure that short and long term maintenance requirements are less or minimal.
4) *Achievement of Potable Quality of Water:* Quality of treated water must be good for direct human consumption so that no further treatment is needed within households.
5) *Water Quality Assessment for Wide Range of Parameters:* Water quality needs to be assessed routinely and quickly for a large numbers of quality parameters related to public health.
6) *Efficient Management of Distribution Network:* Distribution network must be efficient, so that adequate water pressure is maintained in all parts of the distribution network.
7) *Smart Water Metering and Billing to Consumers:* Consumer meters must be accurate and billing to consumers needs to be prompt and accurate.

To meet the requirements water supply service as mentioned above, introduction of modern technologies in new and existing water supply schemes needs to be taken up. The author of this paper has discussed some emerging technologies, which needs to be evaluated further for use in water supply schemes in India.

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II. EMERGING TECHNOLOGIES FOR PUBLIC WATER SUPPLY SYSTEMS IN INDIA

Emerging technologies for improved performance of water supply schemes should include smart technologies. Smart technology can improve data collection and analysis to support proactive decisions and increase the efficiency of water supply schemes. Smart technology can change conventional water supply systems into instrumented, interconnected, and intelligent systems. Instrumented systems have the ability to detect, sense, measure, and record data, while interconnected systems have the ability to communicate and interact with system operators and managers. Intelligent systems have the ability to analyze the situation, enable quick responses, and optimize necessary solutions to problems. Some of the emerging technologies in water supply schemes in India are mentioned and discussed below.

A. Membrane Filtration Technology

At present, in India, conventional water treatment process that includes aeration, chemical clarification, granular media or sand filtration and chlorination, is mostly used in municipal water treatment. Membrane technologies, which are now emerging in many developed countries, are not used.

There are two types of membrane treatment systems. They are low-pressure membrane systems such as microfiltration and ultrafiltration and high-pressure membrane systems such as nanofiltration and reverse osmosis. Low-Pressure Membranes are highly effective for particulate removal, while high-pressure membranes are effective for removal of dissolved organic and inorganic matter.

There is high potential for use of membrane technology in municipal and rural water supply schemes in India, where raw water has harmful chemical constituents.

B. Ion Exchange Technology

This technology is commonly designed as a fixed-bed process, where synthetic resin is packed. When water passes through the resin bed, contaminant ions present in the water are exchanged with ions on the resin surface, thus removing the contaminant ions from the water and concentrating them on the resin.

The resin is frequently regenerated to remove the contaminant from the resin surface and replenish it with the original exchange ion. Types of resins that can be used include strong acid cationic (SAC) resin, weak acid cationic (WAC) resin, strong base anionic (SBA) resin and weak base anionic (WBA) resin.

C. Biological Filtration

Bio-filtration can be used for the biological reduction of various inorganic contaminants in raw water such as nitrate, bromated, perchlorate, chlorate, selenate, etc. Sand, Granular-activated carbon (GAC) or anthracite, can be used for bio filtration.

D. Disinfection of Water by Ultraviolet Irradiation Technology and Ozonation

Ultraviolet (UV) irradiation technology can be used in water treatment plants as a disinfection process that capitalizes on the germicidal effect of UV light. The process is commonly designed in a such a way that water flows in a narrow region around a series of UV lamps. The microorganisms in the water are inactivated through exposure to the UV light.

Ozonation process is based on fundamental chemical principles of ozone reactions in water to produce hydroxyl radicals, This can be used for color removal, taste and odor control, and disinfection. Ozone also has unique benefits over most other disinfectants as it has the ability to inactivate microscopic parasite such as *Cryptosporidium.*

Also, ozone with addition of hydrogen peroxide process can be used for destruction of taste-and-odor-causing compounds, color removal and destruction of micro pollutants, such as volatile organic compounds, pesticides and herbicides. In an ozone plus hydrogen peroxide treatment process, hydrogen peroxide is fed as a liquid to the influent water and an ozone rich gas is fed through fine bubble diffusers at the bottom of a contactor.

In addition the above, mixing of hydrogen peroxide to the influent of a UV irradiation process can be used for destruction of micro pollutants from groundwater.

E. Smart Water Metering

Smart water meters are used to monitor water usage more accurately and help authorities to identify leaks and thefts. Smart water meter can automatically send meter readings to water authorities, so that billing can be done you accurately for water consumed.

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F. Rainwater Harvesting and Urban Runoff Utilisation

Harvesting and store rainwater for use after the rainy season is over could be very useful in water deficient areas. Portable rainwater harvesting and filtration units are available, which can be used as a stand alone system, or integrated into rooftop collection systems. Urban flooding dangers can be mitigated by channelizing runoff into for roadside planting areas at the median or sidewalks by making curb cuts. Permeable pavement can also be used for reducing run off. In India, rain water harvesting is mostly done and promoted within households or premises. There is no project taken up to tap run off from urban roads and public open areas and recycle the run off to water treatment plant and subsequent human consumption. Under ongoing programs and schemes of Government for providing water supply in urban areas, storm runoff recycling projects need to be taken up for design and implementation.

G. Smart Water Grid System

Smart Water Grid system installed in water distribution system can be useful for asset management, leak management, water quality monitoring, automated meter reading and water conservation.

For asset management, pipe network data can be uploaded into an asset management software to improve the identification of high risk pipelines so that pipeline renewal works can be prioritized. This will also give a better understanding of the circumstances leading to pipe failure.

Leak management involves deployment of more advanced leak detection equipment to continuously monitor and analyse leaks, thereby improving response time and minimizing impact to customers. Advance leak detection equipment that can be used include Leak noise localiser, leak noise correlator, high rate sampling pressure sensor, etc. Leak management can also be done by utilizing bulk flow meters to monitor inflows and outflows to zones or sub zones of water distribution network. Combined with automated meter readings from customers premises, mass balance calculations can be done to derive the actual water loss in a zone or sub zone. By this, water authorities can focus their leak survey efforts on areas where high water losses are observed. Statistical analysis of flows and pressures can be carried out to reveal deviations that may indicate a new leak.

For water quality management, water quality sensors can be placed at strategic locations of the network. Real time water quality monitoring sensors can directly measure specific water quality parameters such as pH, turbidity and conductivity. There are also sensors, which can detect any deviations in generic properties of water in order to cover a broader spectrum of contaminants. Also, there are biosensors which can monitor behaviour of living organisms in water to assess the toxicity of water samples. Water quality data analytic systems are used to analyse sensor data in real time and to alert water authorities, when the water quality become unsatisfactory. Thus, water quality management in water distribution network include use of real time sensing methods and data analytical tools in the network operations to achieve real time monitoring and modeling of water quality in the distribution network.

.Automated meter reading (AMR) systems can be used for monthly billing and provide customers with hourly consumption data to better understand and control their water usage. Such data can also be useful to identify suspected water leaks. Thus, AMR data can be used for water consumption behaviour analysis to develop targeted water conservation measures. Aggregated AMR data, together with other smart sensor information, could also be useful for network system performance analysis such as water balance studies. Providing users with real time information on water consumption can lead to changes in water consumption behaviour.

The outcomes of a Smart Water Grid can be summarized as below:

1) Real-time monitoring of asset condition for preventive maintenance. With advanced sensing technologies, data on pipeline condition can be used to plan pipe replacement projects. Pipeline replacement and rehabilitation program can be scheduled properly, so that the right pipes are replaced at the right time.

2) Real-time pressure and water quality monitoring to enhance planning and network operations. Real-time water quality and pressure data allow water authorities to monitor the hydraulic and water quality situation throughout the network. Leaks can be located promptly to minimize water losses. Stress in pipes can be detected early so that actions can be taken to mitigate the risk of pipe bursts. Continuous monitoring of the water quality in the distribution pipelines also provides early warning of potential contamination.

3) Real-time water consumption information to help customers to conserve water. Technologies like automated meter readings and smart water meters provide real-time feedback on water usage to customers. This can enable customers to make informed choices towards water conservation within their homes. In addition, usage data from automated meter readings will enable more accurate demand prediction for optimizing pumping schedules and water required to be treated and pumped.

H. Supervisory control and data acquisition (SCADA) systems

SCADA system can be used to process information and remotely operate and optimize systems and processes such as pressure management, pumping station optimization, control of water treatment plant and reservoirs flows, etc.

I. Geographic information systems (GIS)

GIS can used to store, manage, manipulate and analyze spatial information related to water supply system. It can be used for water supply asset mapping and management, environmental data analysis and management.

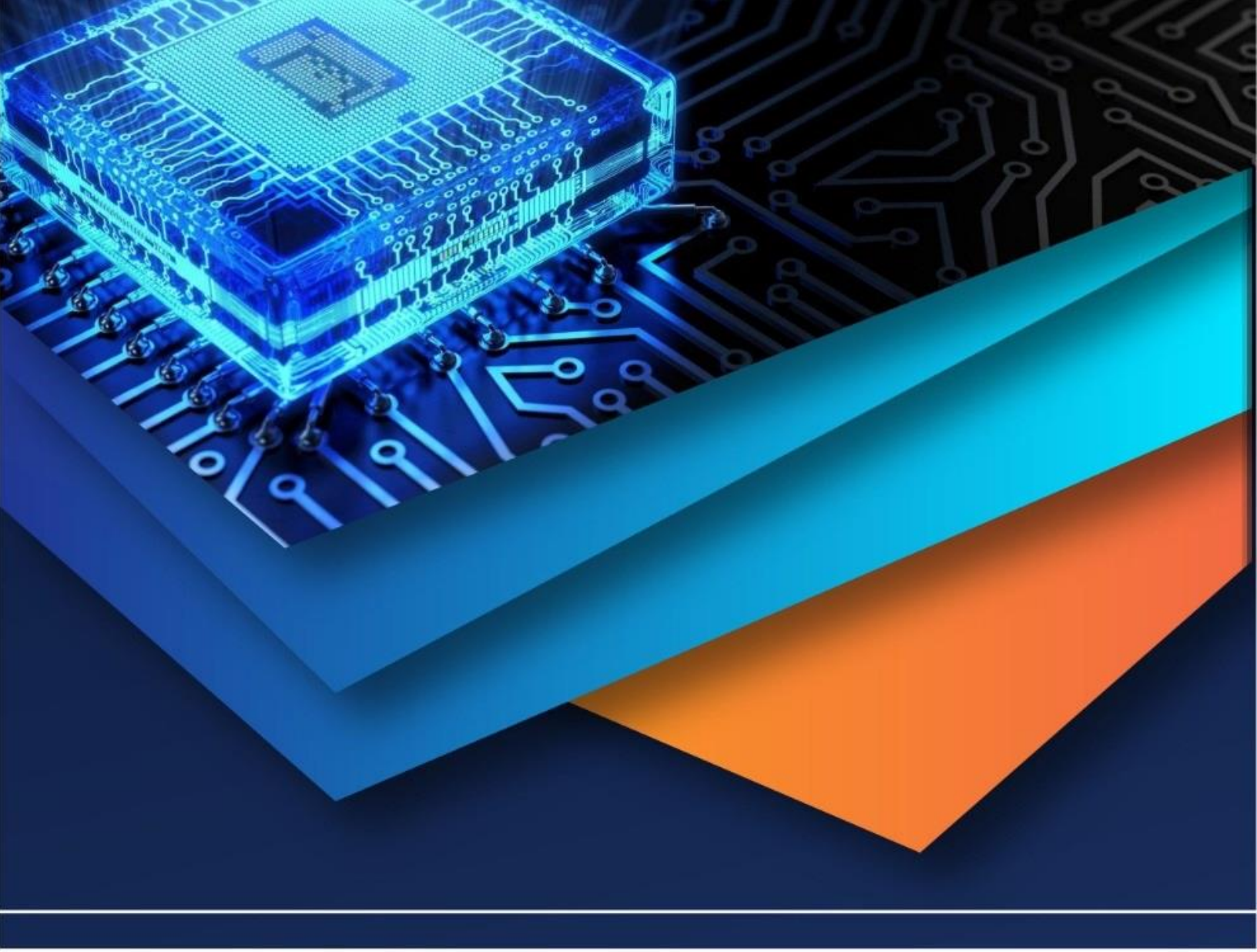
III. CONCLUSIONS

Most of the water authorities in India are still dependent on conventional technologies, which are not efficient on several aspects. Technology upgradation in all existing and new water supply schemes in India is essential and should be taken up at the earliest. Water authorities can upgrade their schemes by taking initiatives such as engagement of specialist consultants or experts, collaboration with research and academic institutions, startups and industries. Necessary fund for such upgradation can become available from Central and State Governments under different ongoing schemes.

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